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# **REDESIGNING THE SUPPLY OF GASSES: CO-MAKERSHIP IN A HOSPITAL**

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## **SOM-theme A Primary processes within firms**

### **Abstract**

Supply chain management in hospitals has been relatively ignored. Due to tight budget constraints attention has been turned to the supply of materials as a possibility to cut costs. This paper describes the operational logistical relation between a hospital and its supplier of gasses and suggests alternatives for a closer, "co-makership"-like relation. To describe and analyse this relation a supply chain concept is elaborated upon that consists of four areas of attention: physical supply, control and co-ordination, organisation and relation, and information systems. Three scenarios are developed for an alternative design of the supply chain. The approach yields a considerable growth in insight for the two organisations into the logistical operation. We think that the approach is also valuable for the analysis and redesign of the logistical aspects in the supply of goods in other organisations.

### **INTRODUCTION**

Nowadays, many organisations pay attention to their purchasing and supply of materials. The research described in this article originated from the question of two organisations: a large hospital and its supplier of medical and non-medical gasses, to improve the supply of gasses. The aim of the project was to investigate whether the existing way of supplying could be transformed into a closer relationship, for which the well-known term "co-makership" was used as a kind of benchmark for the ultimate aim. Although the financial worth of the supply of gasses is only a small percentage of the total amount of purchased goods, it is literally vital. The project was conducted under the direction of the purchasing manager of the hospital and the local operations manager of the gas supplier. Both parties aim for a strategic reorientation in this project. The hospital aims at concentrating on its core service: making people better, while the aim of the gas company is to add more value to its product-service mix: expanding the logistical service to its customers. As the gas company is already market leader in the supply of medical gasses, the underlying aim is to improve its competitive position in

this market as well. Moreover, both parties think that a reduction of overall costs in the supply chain can be achieved if both companies work closer together.

The project is interesting for at least, two reasons.

Firstly, supply chain management in hospitals has been ignored in the literature. For a long time the management of hospitals was primarily focused on improving the medical services offered, ignoring the costs. As a result of the increase in expenses of medical services in general more emphasis is put on offering the best service for the least cost. In The Netherlands, government has put pressure on all parties in health service to keep the percentual increase of costs to certain limits, at least. In order to achieve this a system of budgets is introduced which aims at clarifying the relationship between costs and performance of institutions (comparable with so-called prospective payment systems (PPS) based on diagnostic-related groups (DRGs) which are used in many countries, see Fetter (1991)). As a result, research has been focused towards the application of operations management techniques in hospitals, e.g. Roth and Van Dierdonck (1995) and De Vries (1993). Most attention has been paid to the control and planning of flows of patients, although according to Jarrett (1998) supply logistics needs more attention as well.

A second remarkable and interesting point is that the two organisations have already a long-term relationship and already share knowledge on the use of gasses and there is a mutual trust. The main research question is thus how the operational logistic relation (and the operational co-ordination) of the supply of gasses can be improved. According to New (1996) "one of the most serious problems for theoretical progress in the area (*of supply chain management*) is that it is difficult to interpret reports from the field" (p. 20). Further development of a theory needs, according to New, an untangling of the various components which are part of the chain. Both the academic literature as textbooks seem to stress the strategic and management aspects as trust and commitment, while ignoring to some extent the actual practices and operational aspects of a supplier relationship with its client(s). A further aim of this paper is thus to develop and apply knowledge and instruments to describe and analyse the operational aspects in a supply chain.

In this project we will apply this knowledge in the specific situation. In the course of the project, it turned out that different ways and degrees of co-operation, integration or "co-makership" are possible. We choose therefore, to develop some scenarios or alternatives to help the management of both organisations on deciding about the appropriate course of action. The paper is organised as follows. First, the two organisations and the supply of gasses are introduced. Next, the theoretical background is developed, which is used, in the subsequent sections to describe and analyse the current supply chain. This is the basis to develop three alternative scenarios for redesigning the supply chain. The two last sections pay attention to the evaluation of these redesigns and some concluding remarks.

## **ORGANISATIONAL BACKGROUND**

The current situation in the supply of gasses can be described as a long-term relationship between the two organisations. Within the hospital gas is used by many different departments, different people and for a number of applications. Several types can be distinguished: medical gasses, such as oxygen, laughing gas (nitrous oxide) and nitrogen; special gasses for use in experimental settings; nitrogen for cold storing, used in the laboratories; technical gasses, used in the technical (supporting) departments of the hospital, such as argon. Gas is transported and used in different physical (packaging) forms: bulk gasses transported in carriers and stocked at the hospital location in tanks and distributed via pipes, and cylinders and special cylinders for other applications. The gasses are delivered (on demand from the purchasing department) either in the tanks directly or at the warehouse of the hospital. Further distribution within the hospital is the task of the technical department of the hospital. Delivery to the hospital is usually within 24 hours, but in certain situations faster delivery (within one hour) is possible. The logistical service offered by the gas company to the hospital is limited to delivering (with satisfactory speed and reliability) gas as specified by the orders. The gas company also gives technical support to the different departments within the hospital for example through visits of an account manager.

At the start of the project the purchasing manager and the gas company had little knowledge about the actual operations within the hospital. This lack of knowledge applies to logistical aspects such as the flow and routing of gasses within the hospital, the actual use, the number of stock locations and the control on flow and stock as well as to organisational aspects such as the number of decision-makers, responsibilities and administrative procedures. These last observations regarding the lack of knowledge are an indication for the lack of interest in organisations for the logistical/operational aspect of supply, as was stated in the introduction. It is also an indication of the complexity of supply chain management in hospitals, due to the large number of different kind of processes and the behaviour of medicines.

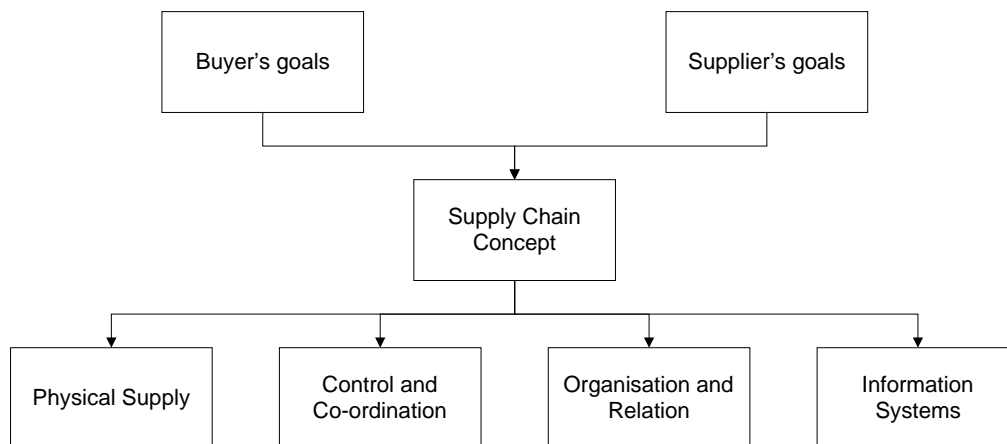
## **THEORETICAL BACKGROUND**

The attention to supply chain management and purchasing has been growing over the last decade. New (1996, p.20) concludes that there are three main ideas behind the recent interest:

- Effective purchasing and distribution;
- A focus on long-term relationships between trading partners; and
- The operational integration of trading organisations.

For the purpose of this paper the last point is of special interest. However, this aspect seems the least developed in the literature. Textbooks like Christopher (1998), Handfield & Nichols (1999), and Lyons (2000) pay attention to important aspects such as supply/purchasing strategy, benchmarking, global pipeline, breaking down barriers, integrative approach, etc, but the operational and logistical details of integration and co-ordination within a supply chain are more or less neglected (Van der Vaart, 2000). While the goals of supply chain management are clear and numerous, the means to achieve these optimal situation in terms of operational integration is much less clear. Reports from the field are, according to New, difficult to interpret and “it is difficult to work out what is “going on”” (p.20), although some examples are clear. For example, Van der Vlist et al. (1997) develop a detailed approach for the control in a supply relationship. Their principal aim is to develop a MRP-like logic for controlling the supply relationship, and other aspects of co-ordination are left out. What is needed is a framework to describe and analyse the supply relationship between two (or more) partners of a chain from various perspectives such as the physical flow of goods, organisational issues, control and planning.

As a starting point for such a frame a model of Ribbers & Versteegen (1992) is used. This model is a pragmatic approach to develop a logistical concept for an organisation. The concept integrates internal and external goals and distinguishes four areas of attention: physical lay-out, control, organisation and information systems. This model is adapted in line of the ideas of Van der Vaart (2000), to be useful in describing and analysing the operational aspects of a supply chain (see Figure 1).



*Figure 1. The supply chain concept*

Starting point in Figure 1 is the idea that within the commercial agreement

between buyer and supplier on prices and specification, there is a mutual agreement on the operational aspects of the supply. Usually, this agreement is not made explicit in a contract, but this might as well be the case. This agreement is based upon the operational goals (which might be conflicting) for the operational and logistical goals of the two organisations. This agreement is called the supply chain concept and is elaborated upon in four areas.

- *Physical supply* deals with the physical flow of goods through and between the two organisations. Important aspects are: the location and amount of inventory in the supply chain; the capacity of means and people; the arrangement of machines and tanks; modes of transportation. Usually, we are especially interested in (unintended) waiting times for goods and barriers for a smooth flow.
- *Control and co-ordination* is the area that deals with planning, monitoring and re-planning of the flow of goods in and between organisations in the supply chain. Important aspects are production and transportation planning in order to meet due dates; the tuning between two organisations; forecasting; decisions regarding the delivery frequencies and amounts of delivery; detailed planning within departments; the way of ordering; and monitoring order fulfilment.
- *Organisation and relation* deals with the lines of authority, the division of responsibilities and the allocation of decisions with respect to the flow of goods in and between two organisations. Important aspects are allocation and division of decisions and responsibilities in and between two organisations; the co-ordination between departments; and the structuring of functions and tasks. Within supply chain management there is a special interest in the responsibility for the control of the flow of goods in each organisation: e.g. a supplier might be responsible for the inventories in the buying organisation.
- *Information systems* deals with the flow of information related to the flow of goods and the control of this flow. Prominent aspects are the computer systems used, the flow of information between the two organisations; the use of documents and other ways of communication; and the use of information and data in the administrative processes to control and record the flow of goods.

In most cases it is logical to analyse a situation in the order in which the four areas are presented. The idea is that the operational aspects of a supply chain basically deal with the physical flow of goods and that the other three areas have to support a smooth flow of the goods. Another aspect of the model is that it clarifies that the third aim as mentioned by New, can be realised by attuning the four areas or, in other words, realising a fit between the four areas.

## CURRENT SUPPLY OF GASSES

In the description of the current situation we will follow the four main areas of the supply chain concept.

### *Physical supply*

Gas is delivered in different quantities, different packaging forms and with a large number of applications. The bulk gasses (stocked in large silos) are automatically controlled and replenished without delay and without other intermediate stocks. Bulk gasses are further distributed by means of a network to the departments and users. The hospital holds stock of cylinders in about hundred different locations: ranging from one cylinder in use by one user to several cylinders grouped together, in use by several users. Some users keep their own safety stock of cylinders, while others rely on the central stock in the hospital's warehouse for their replenishment. For emergencies and breakdowns of the central network some departments have batteries of cylinders. Also within the departments the location of cylinders is quite different: some departments use a central location to stock their cylinders while others do not know exactly where their cylinders are. As a result the Decoupling Point (Hoekstra and Romme, 1992) for each of the supply chains is different: some of the user's orders are delivered from the hospital's central stock, others are delivered from the supplier's local (near the hospital) or central (at the headquarters of this firm) stock, some are made to order. The order cycle ranges from a few hours to twenty four hours. A last point of interest is that empty cylinders have to be returned, which adds to the complexity of the physical flow of goods.

### *Control and co-ordination*

Ordering of gasses is performed in different ways depending on the type and specification of a gas. The level of stock in the central warehouse is monitored by one person, responsible for the ordering and handling of the gasses (the so called gas-employee). He determines actual stock each morning and next, orders are phoned to the supplier, based upon experience. Some special products (made on recipe) are faxed to the supplier to assure the right specification. Bulk gasses are delivered with the help of a direct-measurement system (telemetric), without manual intervention. To realise the agreed delivery of normal products within twenty-four hours the supplier holds inventory, both local and central. Quality in the sense of confirming to specifications is very important and is monitored through Good Manufacturing Practices and tight procedures. There are, however, no problems reported with this aspect.

Within the hospital, most (end-)users phone as soon as a cylinder is empty and a new one is needed. In some cases, these users may have a full cylinder as safety stock. Some departments have a more formalised control structure: each day actual stock (the

number of cylinders and/or the available amount in a cylinder) is controlled and replenished. For some locations, the gas-employee monitors the available stock each morning and sometimes replaces empty cylinders from central stock. In general, the control of stocks within the different departments in the hospital is left to the users and no co-ordinated action is taken to deliberately have inventory on certain points, to combine safety stocks for several departments, or to determine re-ordering levels.

If we look at the supply chain as a whole, it can be characterised as a multi-level supply chain with independent decision-makers who control their own part of the chain. Decisions are not co-ordinated as well as the location and level of inventory. Users are satisfied with the current levels of delivery speed and dependability.

#### *Information systems*

The current situation is a combination of manual and automated systems. Most of the exchange of information between the two companies is not automated. As a result there are still a number of manual activities necessary to have the information available in each companies' information system. E.g. the hospital uses a Cylinder Trace System to know the location of individual cylinders in the hospital (among others for safety purposes). This system is fed with the code of the cylinder as delivery to the user takes place. Moreover, much of the knowledge about reordering levels, location of cylinders and the handling of the flow of information is not easy accessible and not well recorded on paper or an automated information system. Administrative procedures and billing are largely executed by the central departments of both organisations.

#### *Organisation and relation*

As noticed above, the two organisations have a long-term relation, which is well developed in terms of trust, technical support, quality of the products and development of new products. The tasks and responsibilities with respect to the operational aspects of the supply are less developed. Especially the procedures for reordering and the responsibilities for the amount and location of the inventories of cylinders are not attuned between the two organisations and within the hospital. One person in the hospital is responsible for properly maintaining the information regarding the location of cylinders without a good back-up. Moreover, most of his knowledge about the location of cylinders, the usage and reorder levels is not documented at all. Users know little about the relation of their decisions and the level of costs associated. It seems that in parts of the supply chain (in the hospital) nobody is responsible for the flow of gasses.



## **ANALYSIS OF THE CURRENT SITUATION**

First of all, it is remarkable, that both parties in this supply chain are relatively satisfied with the current situation. In fact, no urgent problems are directly visible and the hospital has no complaints about quality, technical support, delivery speed or dependability. Also, the supplier is able to deliver in very short time (less than half an hour) in cases of emergency.

If the current situation is judged from the point of view of an (integrated) supply chain, some interesting observations can be made.

First of all, it is difficult to forecast actual demand on a daily or weekly base. Actual usage depends directly on the kind of patients in the hospital, which is fairly unpredictable. On a more aggregate level (month or year) the demand is stable. It might be clear from the above description that demand emerging for the supplier is rather lumpy, which is reinforced by the intervention of quite a few decision-maker that each use their own procedures to replenish their inventories.

A second point which needs to be addressed is the number of locations for inventory, their function and the amounts available. Despite the frequent and dependant delivery (each day at least) a large number of different locations for stocks are present. It seems that the function of each individual location is to safeguard instant supply. Decisions with respect to inventory levels do not take into account the availability of inventories in other parts of the supply chain. As a result, overall stock in the hospital seems to be too high. Especially the inventory in the central warehouse of the hospital is high, accounting for 30% of the total number of cylinders present and, as rent for the cylinders, 7% of the total bill paid to the supplier.

A third point of concern are the procedures used. Ordering within the hospital, order transmission, administrative control and keeping inventory records and locations up to date take a lot of (manual) paperwork, re-coding and re-entering information in information systems. Moreover, all these time-consuming activities do not result in accurate information regarding the exact location of cylinders of gasses, as is desirable from a safety point of view.

In summary, the logistical performance is good according to the users, but the level of inventory seems too high and the administrative procedures are time-consuming and do not result in accurate information.

## **REDESIGNING THE SUPPLY CHAIN**

The aim of the project with the two organisations was to find alternatives to the present supply of gasses. In order to develop such alternatives an approach was followed inspired by the literature on scenario-planning (Schwartz, 1991). The approach aims at

presenting several alternative designs under various premises. The scenario-approach shows that redesigns aimed at reaching a form of co-makership can be made from different perspectives. Because of the uncertainties with respect to what co-makership could (or should) mean in this supply chain, stimulating discussion and showing various pictures of the future, is particularly meaningful, according to Schwartz (1991). However, we do not claim that the approach used, is an in-depth application of scenario-planning.

In the previous sections a number of elements has been mentioned and used to describe and analyse the current situation in the four areas of attention: physical supply, control and co-ordination, organisation and relation, and information systems. Each of the areas is represented by a number of elements. The elements are derived from the theoretical background as sketched out in the section on the supply chain concept and chosen for their relevance in the actual situation, based on the analysis. It is easy to find the relation: e.g. information systems is represented by two elements; information systems and administrative procedures. Only the element “new safety regulations” is added from a legal point of view.

Next, more or less in line with the scenario approach, the elements are divided in three groups: constant, predetermined and uncertain elements. Constant elements, which will be stable in all scenarios are: volume in demand, location of the two organisations and the packaging forms of gasses. The predetermined elements are those elements that will be altered and, of course, these changes are characterising the different redesigns. Two uncertain elements are distinguished: product requirements and new safety regulations.

In developing the scenarios we choose to alter the elements in a coherent way: e.g. a group of elements is predetermined in each scenario. Two of the scenarios are inspired on the analysis above: the optimising of the flow of information (which seemed far from optimal) and reconsidering the position and function of the inventories. The third scenario develops a kind of ideal situation for an integrated supply chain, representing the most extreme form of co-makership. The three scenarios were labelled: “Optimising Information”, “Optimising Inventory and Supply” and “Integration”. These will be elaborated upon in the next sections. The elements and their changes in each scenario are shown in Table 1.

	<i>Optimising Information</i>				<i>Optimising Inventory</i>				<i>Integration</i>			
	C	V <sub>C</sub>	V <sub>D</sub>	U	C	V <sub>C</sub>	V <sub>D</sub>	U	C	V <sub>C</sub>	V <sub>D</sub>	U
<b>Elements</b>												
Volume of Demand	x				x				x			
Location	x				x				x			
Packaging forms	x				x				x			
Routing of gasses		x					x				x	
Capacity of means		x					x				x	
Capacity of people		x					x				x	
Location of stocks and warehouses		x					x				x	
Ordering			x			x					x	
Complexity in control			x			x					x	
Delivery frequency		x					x				x	
Functions and tasks			x			x					x	
Responsibility and authority			x			x					x	
Information systems			x			x					x	
Administrative procedures			x				x				x	
Product requirements				x				x				x
New Safety regulations				x				x				x

**Legend:**      **C** = Constant element  
**V<sub>C</sub>** = Predetermined element, which remains constant in that scenario  
**V<sub>D</sub>** = Predetermined element, which is redesigned in that scenario  
**U** = Uncertain element

*Table 1. Elements in the three scenarios.*

#### *Optimising Information Systems*

The central idea in this scenario is that the flow of information in the hospital and between the hospital and the supplier needs to be changed. Moreover, it is expected that information needs and flows with respect to gasses, their usage, the exact location of usage and stocking will increase in the near future. Also the information needs with respect to the product requirements will grow and the realisation of safety regulations will be more demanding with respect to information needs, as well.

In stead of maintaining separate information systems, all information is centralised in the Gasses Information System (GIS) of the supplier, including the

location of gasses in the hospital. Through bar-coding on the cylinders the location of each will be known, as well as the level of stock. The information scanned is sent to the supplier with the help of EDI and automatically imported in the GIS. The supplier knows the appropriate (safety) level of stock and reordering can be automated. Financial procedures, which are currently based on ordering, delivery, control and checking of invoices, must follow the changes in the flow of information. At the end of each year an invoice is made based on actual deliveries and usage as it is recorded in the GIS. As a consequence, the supplier becomes responsible for reordering, stock-levels and the provision of adequate information (e.g. for safety purposes).

#### *Optimising Inventory*

The central line of thought in this scenario is that the level of inventory held in this supply chain should be brought to a minimum. In fact, one could argue that this scenario aims at a JIT-like approach as a substitute for the current (s,S)-policy. To support such a JIT-approach, bar-coding and EDI are used as enabling technologies. As a starting point the users of gasses are not allowed to have any inventory, anymore. Next, the central inventory in the hospital is minimised: only a small amount of safety is held for critical gasses. Non-critical gasses are stocked at the warehouse of the supplier. As a consequence for having minimal stock, delivery will happen as soon as a minimum amount of cylinders (a kind of Transport Kan-Ban) is ordered (e.g. five cylinders) and the fixed lead-time of one day will disappear. A number of the control elements from the previous scenario must be used here, as well. Especially, the use of scanning and EDI is comparable. The GIS will grow in importance compared to the current situation, but much of the information will be handled by the hospital. Also administrative procedures will, to a large extent, remain the same. The supplier will have a larger responsibility for instant delivery: as soon as aggregate demand has reached the minimum Kan-Ban level a delivery has to be made. The present regularity in deliveries will drastically change.

#### *Integration*

The focus in this scenario is to reach one truly integrated supply chain: optimal service for the hospital and a redesign along all four elements of the logistical concept. This redesign combines parts of the previous two, but some aspects are added. This might be needed as both market pressure and safety regulations grow in importance. The main idea behind this redesign is to do as if the supply is handled by one company. The central warehouse at the hospital disappears: stock of cylinders is placed at a limited number of central locations for a number of users/departments. The motive for these centralised locations is to combine less inventory and inventory locations with instant delivery into safety stock for several users. Locations are automatically restocked dependent on actual usage. Restocking of these locations means replacing all cylinders

present (even those that are not used) as a kind of package. The supply of bulk gasses remains the same.

The cylinders are automatically reordered, as removing or using a cylinder will be registered in the information system of the supplier. This system registers the exact number of cylinders present on the various locations (for safety-purposes). To prevent too much deliveries some safety stock will be needed, especially for critical gasses. In fact, most activities and the responsibility for adequate fulfilment are located at the supplier, who more or less adds to his product the activities of a logistics service provider. Actually hiring a third party for these activities is not an alternative due to the necessary technical know-how, safety regulations and GMP practices.

The costs are not directly related to the number of activities and the amount of gas delivered, but payment for the service will be a negotiated total amount.

## EVALUATION

The three alternatives presented have to be judged against each other. Some straightforward criteria are: customer service, financial costs/benefits, ease of implementation, and degree of co-makership.

### *Service*

According to Christopher (1998, p. 24), “customer service may be defined as the consistent provision of time and place utility”. Important aspects of this performance measure are reliability and dependability although aspects such as after-sales service, pre-transaction support need to be addressed as well. Performance is already quite satisfactorily and the aim of each of the alternatives is to maintain that high level, at least. Moreover, the pre-transaction customer service (e.g. the ease of ordering) improves as more automated ordering is introduced. Tracking and tracing of cylinders in the hospital is improved, as the presence of cylinders on each location is better documented.

### *Costs and benefits*

We will limit ourselves to a few qualitative comments with respect to the costs and benefits of each scenario. The present costs for the hospital are relatively easy to determine, and both parties know these costs: the largest and most visible part of these costs is the total bill paid to the supplier. Organisational and administrative costs are less tangible and visible. However, the determination of the costs and the changes in these costs in the various scenarios of the supplier is relatively difficult and directly affects the competitive and commercial relation of the two organisations. Moreover, some bargaining will be needed in all scenarios. The first scenario needs a large

investment in information systems of the supplier, which costs, however, cannot be attributed to this project only. The application needed will be used for other customers as well. This scenario reduces the costs of the hospital considerably with respect to the flow of documents and the associated activities in administration. The Optimising Inventory scenario will cause a lower level of inventory in the hospital, partly at the cost of an increase in transportation costs. In sum, we expect some savings: currently a large amount of the bill paid is directly related with the level of inventory. The Integration scenario needs a number of additional investments in decentralised locations to stock cylinders in a safe way. This is necessary because of the safety regulations presumed in this scenario. On the other hand the central warehouse will disappear and the transportation costs are assumed not to grow.

In summary, for all the scenarios total costs in the two organisations together, will not tend to be higher than they are in the current situation, but there will be changes in the different cost components. Moreover, the bill paid to the supplier might be higher, while less visible costs (e.g. administrative work) in the hospital decline.

### *Implementation*

The Information Optimising approach seems to be the scenario that is the easiest to implement. Moreover, this scenario can be implemented in a number of steps. The relative ease is due to the fact that “only” an information system has to be adapted and no changes are necessary in physical means while organisational procedures can be adapted gradually. The other two scenarios need some more time to be implemented due to such changes. Moreover, implementation relies on the trust of both organisations in each other. Also the proper division of costs and benefits needs to be solved. Direct implementation of the Integration scenario seems risky, due to the large difference between the present and suggested way of operating. A step-by-step approach, which starts with the implementation of aspects as suggested in one of the other two scenarios, may reduce such risks.

### *Co-makership*

This study started with the wish of both organisations to develop a kind of co-makership relation without a clear idea of what co-makership should or could entail. The three scenarios each develop an aspect of such a relation. In fact, different levels of co-makership or close co-operation are possible and visualised by means of the scenarios. The Optimising Information and Optimising Inventory scenarios each show a considerable amount of co-operation. A considerable amount of responsibility and execution of supply tasks are transferred to the supplier. The Integration scenario combines parts of the two other designs into an even more close or “full” co-makership relation. The actual implementation is possible if judged from a supply management angle, but depends on mutual trust, relative power and the negotiations on the

purchasing contract.

## CONCLUSION

Much has been written about supply chain management in recent years. This paper shows an approach for analysing a supply chain relation between two organisations or, more specific, the operational logistic relation. This approach may need further elaboration, but in this study sufficiently helped to analyse the *logistical* relation. This aspect seems to be ignored in much of the purchasing and supply chain management literature. If attention is paid to logistical aspects in the literature, the level of detail is usually not sufficient to guide the analysis of real-life situations. The development of this instrument was valuable for the supplier as this way of working and analysing can be used in the development of their relation with other customers, as well. The hospital improved its insight into the internal material handling and into the operational relation with the supplier.

A second point, that is worth mentioning, relates to the development of scenarios. These scenarios show that developing a supply chain management relation is possible from different angles: each stressing a specific aspect of the logistical relation and making a choice for optimising that aspect. In other words, different interpretations of developing a supply chain relation seem to exist. The literature stresses more or less one way of organising a supply chain, while different options might exist and might be possible. This idea may be further developed in the future.

A last remark addresses the practical value of this study. First of all, it was remarkable that management (especially in the hospital) did not know very much of the operating of the supply of gasses. The knowledge, described in this paper, was dispersed among different persons and departments in the two organisations without an image of the whole “picture” of the supply. This in itself stimulated discussion and made actors ready for discussion and change. This discussion was further stimulated by the three scenarios that highlight avenues for improvements. The starting point for this study as formulated by the two managers, was transformed into a number of concrete designs, which are valuable for both organisations. An actual choice has not yet been made, however. This postponement is largely due to the slowness of decision-making in the hospital and the personnel consequences in the hospital, as well as to the need to work out the financial consequences for both parties.

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